



PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P3072 WO ORD	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEAA416)	
International application No. PCT/GB 03/01266	International filing date (day/month/year) 25.03.2003	Priority date (day/month/year) 27.03.2002
International Patent Classification (IPC) or both national classification and IPC G11C19/08		
Applicant EASTGATE INVESTMENTS LIMITED ET AL.		

<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 4 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 3 sheets.</p>
<p>3. This report contains indications relating to the following items:</p> <p>I <input checked="" type="checkbox"/> Basis of the opinion</p> <p>II <input type="checkbox"/> Priority</p> <p>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p>IV <input type="checkbox"/> Lack of unity of invention</p> <p>V <input checked="" type="checkbox"/> Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p>VI <input type="checkbox"/> Certain documents cited</p> <p>VII <input type="checkbox"/> Certain defects in the international application</p> <p>VIII <input type="checkbox"/> Certain observations on the international application</p>

Date of submission of the demand 06.10.2003	Date of completion of this report 30.07.2004
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer Colling, P Telephone No. +31 70 340-4429 

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB 03/01266

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1-17 as originally filed

Claims, Numbers

1-13 received on 09.07.2004 with letter of 06.07.2004

Drawings, Sheets

1/8-8/8 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
☐ the language of publication of the international application (under Rule 48.3(b)).
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority in written form.
☐ furnished subsequently to this Authority in computer readable form.
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

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5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-13
	No: Claims	
Inventive step (IS)	Yes: Claims	1-13
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-13
	No: Claims	

2. Citations and explanations

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following document:

D1: US-A-3 811 120 (BOBECK A) 14 May 1974 (1974-05-14)

Document D1, which is considered to represent the closest prior art document discloses (see column 2, line 33 - column 4, line 37 and figures 1-3; the references in parentheses applying to this document) a data storage device (10) for storing digital information (information bits) in a readable form comprises one or more memory elements (12), each memory element comprising a planar magnetic conduit (channels 13) capable of sustaining and propagating a magnetic domain wall (15) formed into a continuous propagation track wherein each continuous track is provided with at least one inversion node (end of channel 13).

The subject-matter of claim 1 thus differs from D1 in that the magnetisation direction of a domain wall is changed at the inversion node under the action of a suitable applied field, each inversion node comprising a portion in which a direction change away from the initial path and a subsequent direction change back to the initial path are provided in the conduit such that no direct propagation path is possible across the deviating portion.

The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

The problem to be solved by the present invention may be regarded as the provision of a data storage device which compactly stores digital data.

The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) since nowhere in the cited prior art documents a conduit structure as described in claim 1 is suggested to be of use as an inversion node whereby the magnetisation direction of a domain wall propagating along said conduit is changed in such a manner as to serve as a memory element in a data storage device.

Claims 2-13 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

CLAIMS

1. A data storage device for storing digital information in a readable form comprises one or more memory elements, each memory element comprising a planar magnetic conduit capable of sustaining and propagating a magnetic domain wall formed into a continuous propagation track, wherein each continuous track is provided with at least one inversion node whereat the magnetisation direction of a domain wall propagating along the conduit under action of a suitable applied field is changed, each inversion node comprising a portion in which a direction change away from the initial path and a subsequent direction change back to the initial path are provided in the conduit such that no direct propagation path is possible across the deviating portion.
- 15 2. A data storage device in accordance with claim 1 wherein each continuous track is provided with at least one inversion node whereat the magnetisation direction of a domain wall propagating along the conduit under action of a suitable applied field is substantially reversed.
- 20 3. A data storage device in accordance with claim 1 or claim 2 wherein each continuous track is provided with a large plurality of inversion nodes.
- 25 4. A data storage device in accordance with any preceding claim wherein a conduit is formed into a closed loop to comprise a continuous propagation track.
5. A data storage device in accordance with any preceding claim wherein a conduit does not form an entire closed loop but a chain of inversion

nodes, and means are provided to transfer data between the two ends thereof so that data is still able to circulate around an apparently closed loop, the means comprising a data writing facility at one end of the chain and data reading facility at the other end of the chain, and additional
5 circuitry to feed the data back electronically from the output of the chain to the input of the chain.

6. A data storage device in accordance with any preceding claim wherein deviations comprise 90° deviations from the initial path of the conduit.
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7. A data storage device in accordance with any preceding claim wherein deviations from the initial path occur gradually over a distance along the conduit track.
- 15 8. A data storage device in accordance with any preceding claim wherein the inversion node comprises a cycloidal portion within a conduit loop structure or a topological equivalent of such a structure.
- 20 9. A data storage device in accordance with claim 8 comprising a plurality of such cycloidal portions provided in each loop.
10. A data storage device in accordance with claim 9 comprising a number of magnetic conduits formed into closed loops each comprising a plurality of cycloids serving to effect abrupt directional reversals in a
25 magnetisation direction of a domain wall passing thereacross.
11. A data storage device in accordance with one of claims 8 to 10 wherein each cycloid has a turning radius which is in the range three to ten times the conduit width.

12. A data storage device in accordance with any preceding claim wherein the magnetic conduit comprises a particular generally planar magnetic wire on a suitable substrate.

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13. A data storage device in accordance with claim 12 wherein the magnetic wire comprises a magnetic nanowire with a thickness of between 2 nm and 25 nm and a width of between 50 nm and 1 μm .

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